ECOLOGICAL ASPECTS AND REPRODUCTIVE PHENOLOGY OF *ACROTHAMNION PREISSII* (SONDER) WOLLASTON (CERAMIACEAE, RHODOPHYTA) IN THE TUSCAN ARCHIPELAGO (WESTERN MEDITERRANEAN)

Luigi PIAZZI, Giuseppina PARDI and Francesco CINELLI

Dipartimento di Scienze dell' Ambiente ■ del Territorio — Università di Pisa,
Via Volta, 6 — 56100 Pisa — Italia.

ABSTRACT This paper reports the results of a study about the geographical distribution of *Acrothamnion preissii* (Sonder) Wollaston in the Tuscan Archipelago (Italy). Moreover, vertical distribution, seasonal dynamics and reproductive phenology of *A. preissii*, on hard bottom and *Posidonia oceanica* beds, were investigated around Gorgona Island. Some considerations regarding the effects of *A. preissii* turfs on benthic communities are reported.

RÉSUMÉ — Les auteurs présentent les résultats d'une étude sur la distribution géographique d'*Acrothamnion preissii* (Sonder) Wollaston dans l'Archipel Toscan (Italie). En outre, l'évolution saisonnière et la phénologie reproductive de l'espèce ont été étudiées dans l'île de Gorgona, sur les fonds rocheux et sur la "matte" vivante de *Posidonia oceanica*. Enfin, quelques considérations sur les effets des gazons de *A. preissii* sur d'autres peuplements benthiques sont présentées.

KEY WORDS: *Acrothamnion preissii* (Sonder) Wollaston, geographical distribution, ecology, reproductive phenology, Tuscan Archipelago.

INTRODUCTION

In recent years many tropical algae have appeared in the Mediterranean. Three major routes of access into the Mediterranean are the opening of the Suez Canal, the increase in shipping and the development of aquaculture and public aquariums (Verlaque, 1994). Some species able to adapt to new environments have become so widespread that they represent a threat to the structure of benthic communities (Meinesz & Hesse, 1991; Knoepffler-Peguy *et al.*, 1985).

One of the first tropical species identified in the western Mediterranean was *Acrothamnion preissii* (Sonder) Wollaston (Rhodophyta, Ceramiaceae), which seems to have started its colonization from the coast near Livorno (Cinelli & Sartoni, 1969).

Since then it has spread around the Tuscan Archipelago islands (Cinelli *et al.*, 1984; Pardi *et al.*, 1993) and along the Tuscan (Cinelli & Sartoni, 1970; Cinelli *et al.*, 1984), Ligurian (Bianchi & Morri, 1993) and French coasts (Boillot *et al.*, 1982; Thélin, 1984; Verlaque, 1994). Sometimes the alga is so infesting as to modify autochthonous benthic communities (Salghetti-Drioli *et al.*, 1985). To date, *A. preissii* biology and ecology have not been studied in the Mediterranean; this work aims to give a revision of the distribution of *A. preissii* along the Tuscan coast and some information on the ecology and reproductive phenology of this species. In particular, three ecological aspects were investigated: importance of the kind of substrate for *A. preissii* development, vertical distribution and seasonal dynamics, both on hard bottom and *Posidonia oceanica* (L.) Delile beds.

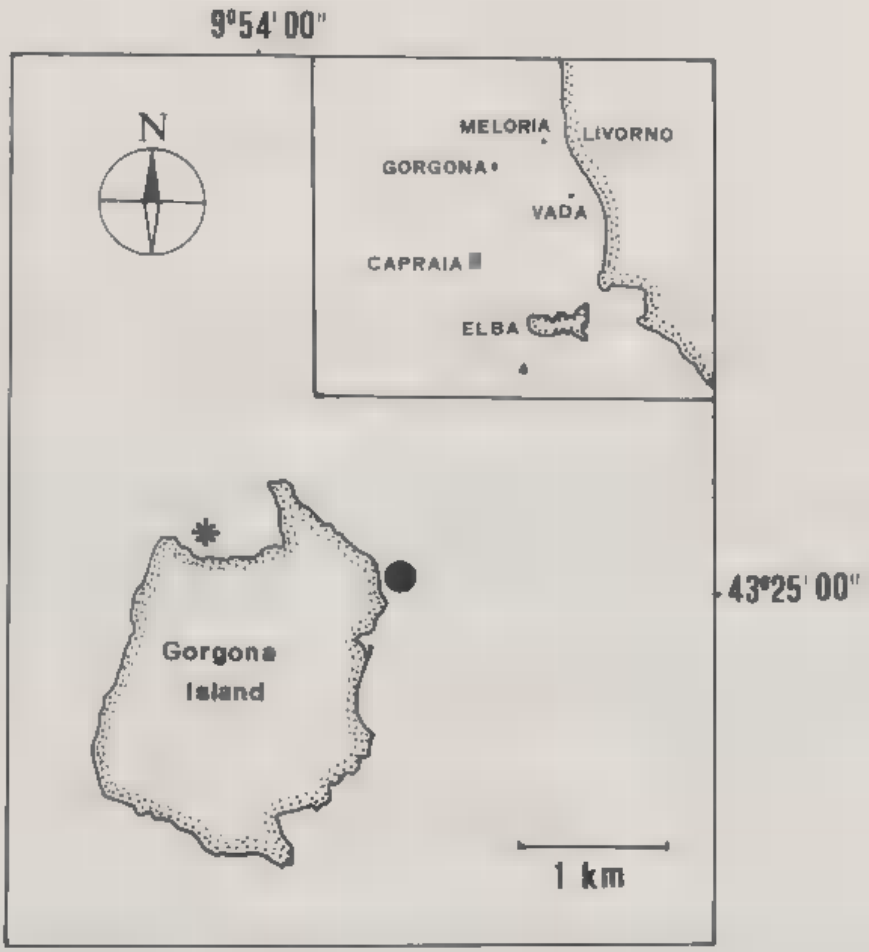

Fig. 1 — Map of Gorgona Island showing sampling sites (* = hard bottom; ■ = *Posidonia oceanica* beds)

MATERIAL AND METHODS

A survey of the Tuscan coast and Tuscan Archipelago was carried out, by field observation, from 1990 to 1994, to evaluate the diffusion of *A. preissi*. The study of ecological aspects and reproductive phenology was carried out around Gorgona Island (Tuscan Archipelago), where the species has colonized large zones of infralittoral bottoms. The hard bottom sampling site was in Cala Maestra, on the northern side of the island (Fig. 1); six stations were chosen along a transect at 35 m, 25 m, 12 m, 6 m, 3 m and 1 m deep; records were collected by SCUBA diving, scraping off surfaces of 400 cm^2 (Boudouresque, 1971). The samplings on the *P. oceanica* beds were done in the eastern part of the island (Fig. 1); ten shoots were collected along a transect at 25 m, 12 m and 6 m deep. *A. preissii* abundance was estimated by percentage cover and quantitative dominance (Boudouresque, 1971). Samplings were repeated in each season (June, September, December, March) and bimonthly records were collected at the same depths to evaluate the presence of reproductive structures.

Fig. 2 — *Acrothamnion preissii* (Sonder) Wollaston turfs on *Posidonia oceanica* (L.) Delile shoots. Bar = 2.8 cm

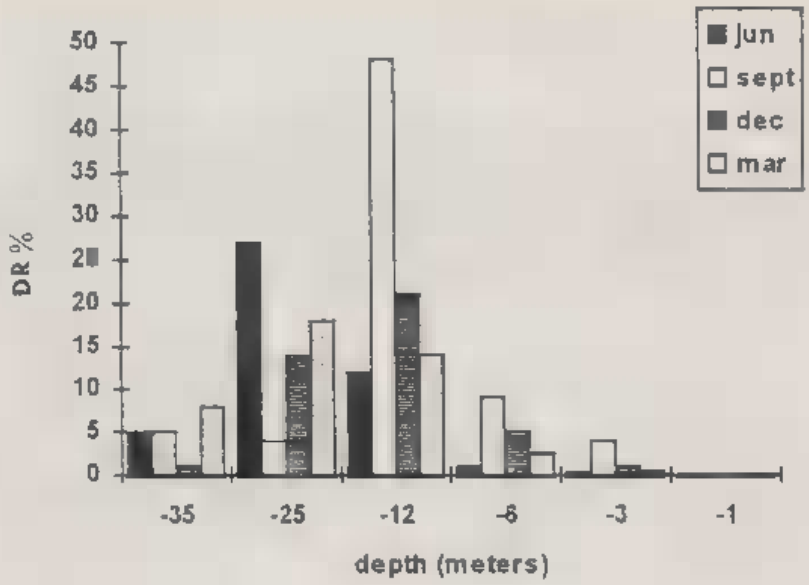

Fig. 3 — *Acrothamnion preissii* quantitative dominance on hard bottom.

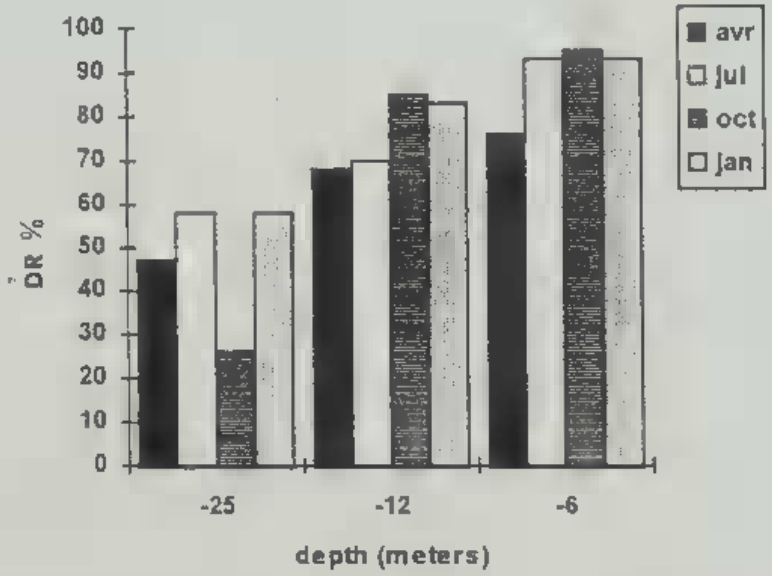

Fig. 4 — *Acrothamnion preissii* quantitative dominance on *Posidonia oceanica* shoots.

RESULTS

The comparison between the present study and previous papers (Cinelli *et al.*, 1984) shows that *A. preissii* has not extended its area in recent years. At present the zone colonized by *A. preissii* includes the Tuscan coast between Livorno and the Gulf of Follonica and the islands of Gorgona, Capraia and Elba (Fig. 1). Field observations showed the existence of a zone between Meloria and Vada Shoals (Fig. 1) where *A. preissii* is dominant on the infralittoral sea bottom and often forms dense turfs which cover rocks, other algae and seagrasses (Fig. 2).

The study on the rocky bottom showed the presence of *A. preissii* along all transect; the greatest quantitative dominance occurred in September and between 12 m and 25 m, while it is infrequent at depths shallower than 6 m (Fig. 3). On *P. oceanica* shoots *A. preissii* shows a high quantitative dominance, especially in shallower stations (Fig. 4), while seagrass leaves are poorly colonized all along the transect and only on the basal part (Fig. 5).

To date, in the Mediterranean only the tetrasporophytic phase has been described (Cinelli & Sartoni, 1970; Thélin, 1984); during this survey tetraspores and gonimoblasts were found; tetraspores (Fig. 6) were present between September and January on the hard bottom, while gonimoblasts were present in November and January on *P. oceanica* shoots (Tab. 1). According to Wollaston's description (1977), mature gonimoblast is formed by two lobes, and develops on young pinnae near branch apices; the structure is protected by pinnae originated from lower axial cells (Fig. 7).

CONCLUSIONS

From this study it results that *A. preissii* distribution on the hard bottom is related to bathymetric gradient, with a greater abundance between 12 m and 25 m, while on *P. oceanica* shoots, where the light is reduced by the leaf layer, the quantitative dominance of the alga is high throughout the transect. According to this distribution, connected with light intensity, *A. preissii* seems to be a sciaphilous species. The absence of *A. preissii* from the upper part of *P. oceanica* leaves, also in deeper stations, seems to show its preference for low hydrodynamism biotopes.

As for its structural characteristics, *A. preissii* is able to colonize rocky bottoms, other algae and marine seagrasses, but this study shows that *P. oceanica* shoots seem to represent the best substrate for settling and development.

The reproductive structures were found between the end of summer and the beginning of winter. This period does not coincide with the greatest vegetative growth, which occurs between June and September. Cinelli *et al.* (1970) discovered tetraspores near Leghorn in August, and Thélin (1984) at Camarat Cape (Var) in December.

This work shows that *A. preissii* tends to monopolize the available substrate constituting monospecific populations, particularly on *P. oceanica* shoots, where

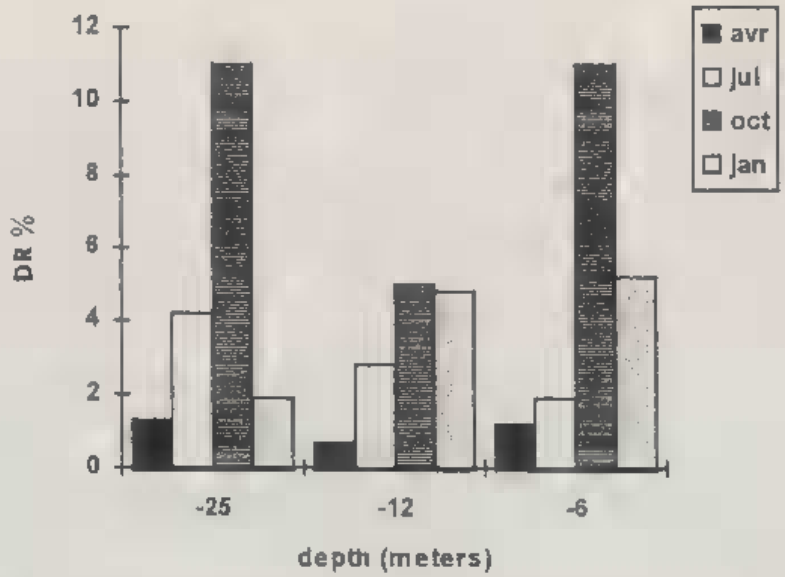

Fig. 5 — *Acrothamnion preissii* quantitative dominance on *Posidonia oceanica* leaves.

Fig. 6 — Axes of *Acrothamnion preissii* bearing tetrasporangia. Bar = 80 µm

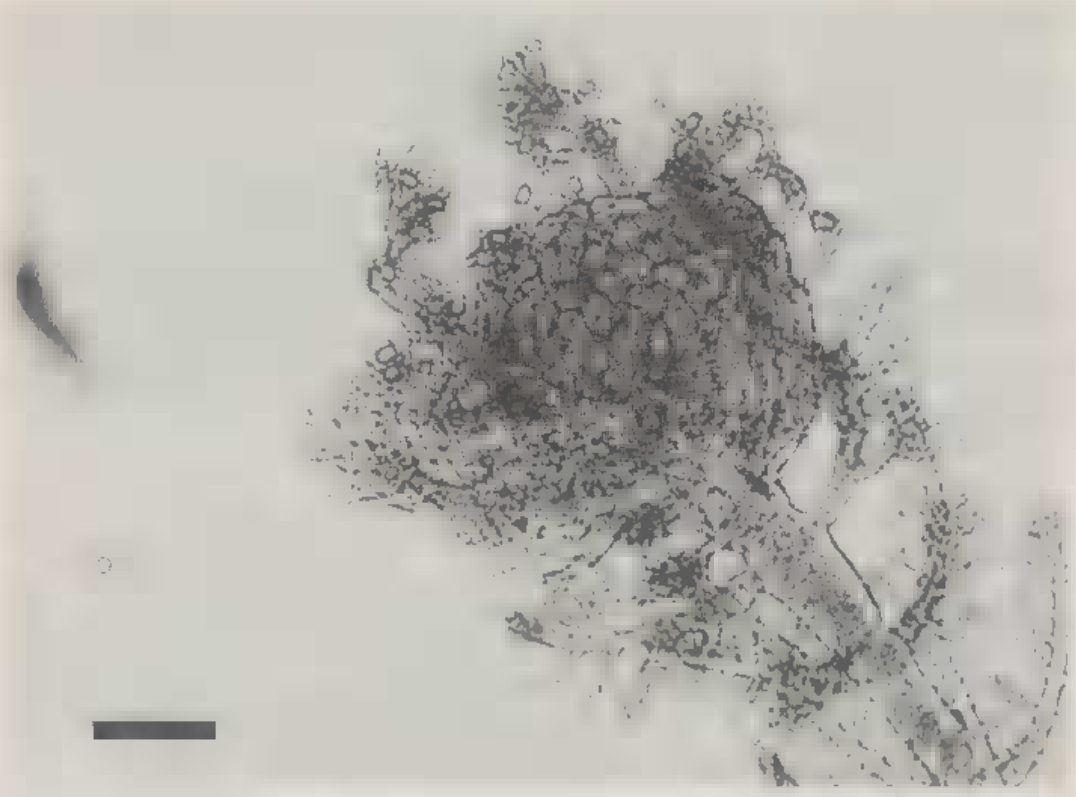

Fig. 7 — Axes of *Acrothamnion preissii* bearing gonimoblast. Bar = 140 µm

depth (meters)	jul	sept	nov	jan	mar	may
-35	-	-	t	t	-	-
-25	-	-	t	t	-	-
-12	-	t	t	g	-	-
-6	-	t	t g	g	-	-
-3	-	-	t	t	-	-
-1	-	-	-	-	-	-

Tab. 1: Presence of reproductive structures of *Acrothamnion preissii* (t = tetraspores; g = gonimoblasts).

quantitative dominance achieves values near 100 %. This behaviour is characteristic of turf-forming species, whichs due to their filamentous structure and quick vegetative propagation, are more competitive than erect algae (Sousa *et al.*, 1981; Airoldi *et al.*, 1994). *A. preissii* turfs become good sediment traps and, in this way, it may deprive some spatial competitors of substrate for attachment (Littler *et al.*, 1983). The spread of this species may change the structure and lower diversity of phytobenthic communities.

In recent years, in deeper bottoms the *A. preissii* seems to have suffered from competition with the pantropical turf-forming alga *Polysiphonia setacea* Hollenberg, recently found in the north-west Mediterranean (Airoldi *et al.*, 1995).

Even if *A. preissii* has not extended its area in recent years, its effects on benthic communities, prompts the continuation the survey and the study of the biology of this species, also in other areas of the Mediterranean.

REFERENCES

AIROLDI L., RINDI F. & CINELLI F., 1994 — Structure of a subtidal algal assemblage dominated by *Polysiphonia setacea* Hollenberg in Western Mediterranean. *Giornale Botanico Italiano* 128: 782-783.

AIROLDI L., RINDI F., PIAZZI L. & CINELLI F., 1995 — Distribuzione di *Polysiphonia setacea* (Rhodomelaceae, Rhodophyta) Hollenberg in Mediterraneo e possibili modalità di diffusione. *Biologia Marina Meditterranea* (in press).

BIANCHI C. N. & MORRI C., 1994 — Southern species in the Ligurian Sea (Northern Mediterranean): new records and a review. *Bollettino dei Musei e degli Istituti biologici dell' Universitá di Genova* 58-59: 181-197.

BOILLOT A., CARAM B. & MEINESZ A., 1982 — Sur l'*Acrothamnion preissii* Rhodophycée (Céramiale, Céramiacée) nouvelle pour la flore française. *Cryptogamie Algologie* 3 (1): 21-24.

BOUDOURESQUE C. F., 1971 – Méthodes d'étude qualitative et quantitative du benthos (en particulier du phytobenthos). *Tethys* 3 (1): 79-104.

CINELLI F. & SARTONI G., 1969 – *Acrothamnion* J. Ag. (Rhodophyta, Ceramiaceae): genere algale nuovo per il mare Mediterraneo. *Pubblicazioni della Stazione Zoologica di Napoli* 37: 567-574.

CINELLI F. & SARTONI G., 1970 – *Acrothamnion preissii* (Sonder) Wollaston: descrizione del tetrasporofito. *Pubblicazioni della Stazione Zoologica di Napoli* 38: 221-222.

CINELLI F., SALGHETTI U. & SERENA F., 1984 — Nota sull'areale di *Acrothamnion preissii* (Sonder) Wollaston nell' Alto Tirreno. *Quaderni del Museo di Storia Naturale di Livorno* 5: 57-60.

KNOEPFFLER-PEGUY M., BELSHER T., BOUDOURESQUE C. F. & LAURET M., 1985 — *Surgassum muticum* begins to invade the Mediterranean. *Aquatic Botany* 23: 291-295.

LITTLER M. M., MARTZ D. R. & LITTLER D. S., 1983 — Effects of recurrent sand deposition on rocky intertidal organisms: importance of substrate heterogeneity in a fluctuating environment. *Marine Ecology Progress Series.* 11: 129-139.

MEINESZ A. & HESSE B., 1991 — Introduction et invasion de l'algue tropicale *Caulerpa taxifolia* en Méditerranée nord-occidentale. *Oceanologica Acta* 14 (4): 415-426.

PARDI G., PAPI I., PIAZZI L. & CINELLI F., 1993 — Benthic marine flora in the Tuscan Archipelago. A second contribution: Isle of Gorgona. *Giornale Botanico Italiano* 127 (4): 797-819.

SALGHETTI-DRIOLI U., PARDI G. & CINELLI F., 1985 — Studio sull'epifitismo algale di un *Thanato-Posidonietum oceanicae* del litorale di Livorno. *Bollettino delle sedute Accademia Gioenia di Scienze Naturali, Catania* 18 (326): 455-462.

SOUSA W. P., SCHROETER S. C. & GAINES D., 1981 — Latitudinal variation in intertidal algal community structure: the influence of grazing and vegetative propagation. *Oecologia* 48: 297-307.

THÉLIN I., 1984 — Nouvelle signalisation d'*Acrothamnion preissii* (Sonder) Wollaston sur les côtes françaises de Méditerranée. *Travaux scientifiques du Parc national de Port-Cros* 10: 171-172.

VERLAQUE M., 1994 — Inventaire des plantes introduites en Méditerranée: origines et répercussions sur l'environnement et les activités humaines. *Oceanologica Acta* 17 (1): 1-23.

WOLLASTON E. M., 1968 — Morphology and taxonomy of southern australian genera of Crouanieae Schmitz (Ceramiaceae, Rhodophyta). *Australian Journal of Botany* 16: 217-417.